NOTES ON THE REPRODUCTIVE BIOLOGY AND CAPTIVE PROPAGATION OF THE AMERICAN ALLIGATOR

by
TED JOANEN and LARRY McNEASE
Louisiana Wildlife and Fisheries Commission
Grand Chenier, Louisiana

ABSTRACT

Wild captured adult alligators (*Alligator mississippiensis*) over a 4½ year period exhibited a nesting rate of 50 percent. Clutch size averaged 39.5 eggs per nest. Fertility rates averaged 75.4 percent. Successful stocking rates of one male to four females were achieved in a one-half acre enclosure. Pen construction methods and maintenance techniques were implemented to simulate natural marsh conditions, thereby encouraging breeding and contributing to the health of the alligators. Diseases posed no problem during the investigation although fighting and escapes were major concerns during the early phases of the study.

INTRODUCTION

The decline of the wild populations of crocodilians throughout the world has proliferated conservation efforts in captive rearing of various crocodilian species. Countries in Africa and Asia, New Guinea and the United States have been involved in rearing station and farming programs for many years (Blake, 1970; Pooley, 1971, 1973; Downes, 1973; Yangprapakorn, et al., 1971; Joanen and McNease, 1971). The programs varied from full fledged farming operations to a rearing station approach where wild produced eggs were artificially incubated with a subsequent direct release of young into the wild.

Louisiana has actively researched alligator farming programs since 1964 (Chabreck, 1967; Joanen and McNease, 1971, 1974). The earlier studies simply centered around the housing of adult animals in captivity for breeding purposes. Later investigations incorporated recent findings involving social and environmental parameters into pen design and stocking rates (Chabreck, 1965; Joanen, 1969; Joanen and McNease, 1970, 1972a; McNease and Joanen, 1974). Louisiana's initial installations consisted of five ¼ acre breeding ponds stocked at varying rates. This study provided valuable information on breeding biology and pen design. However, multiple nesting (two females nesting in one pen) occurred only once during the five year study. Telemetric studies conducted by Joanen and McNease in 1970 and 1972, investigating the movement and habitat preferences of wild adult alligators, helped shed new light on the habitat requirements for captive wild caught adults. These studies indicated that courtship and copulation took place in open water; bayous, canals, or large marsh lakes and ponds. The remainder of the year (summer, fall and winter), the adult female's activities were largely centered around small potholes and dens in heavily vegetated portions of the marsh while the male retained his preference for open deep water.

During the fall of 1970, six pens were constructed on Rockefeller Refuge.

The objectives of the study were to:

1. Develop proper methods of maintaining alligators under captive conditions such as stocking rates, pen sizes, pen construction technology, and feeding rates.
2. Relate propagation techniques to reproductive success.
3. Study behavior, particularly reproductive oriented activities.
4. Determine age at sexual maturity.
5. Develop efficient methods of artificial egg incubation.
6. Determine problems, especially diseases and ailments, which affect the health of the breeding stock.

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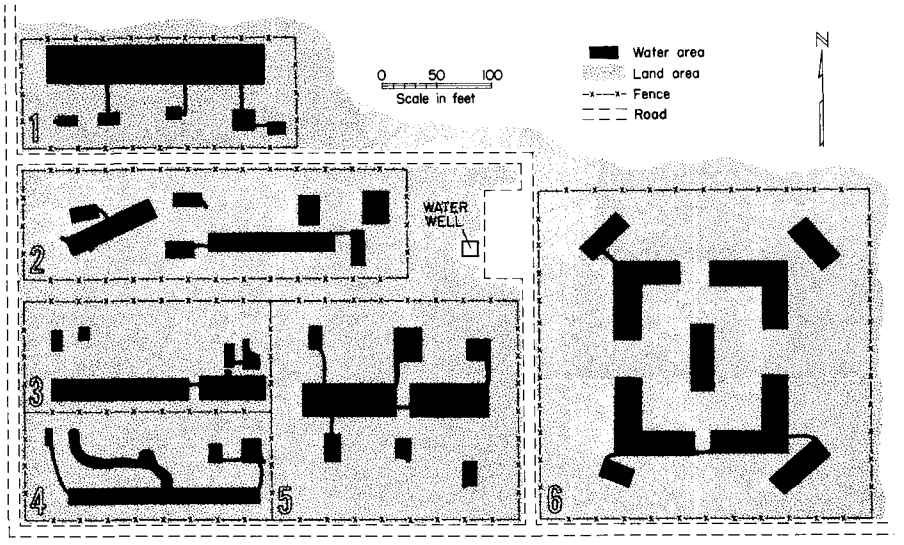


Figure 1. Pen design for captive alligators, Rockefeller Wildlife Refuge 1975.

METHODS AND MATERIALS

Pen Design

Construction was begun in 1970 on six pens varying in size from ½ acre to approximately two acres (Figure 1). Deep water courtship areas were constructed by digging rectangular ponds 15-60 feet by 100-175 feet by six feet deep. Small ponds, 10 by 20 feet, were constructed adjacent to the courting ponds. The number constructed per pen was correlated with anticipated stocking rates of females and numbered up to six. Each pen was fenced with 1" × 2" × 60" welded wire or 2" × 4" × 72" welded wire fence. A two foot section of ½" mesh poultry wire retainer added to the top of the fence and angled at 90° prevented escape. Creosoted 1" × 6" × 16' boards were installed at the bottom of the fence flush with the ground to serve as an anchoring point for the fence and added some degree of strength.

Natural vegetation including wiregrass *(Spartina patens)*, roseau cane *(Phragmites communis)*, buckbrush *(Baccharis halimifolia)*, bullwhip *(Scirpus californicus)* and marsh-fleabane *(Pluchea* sp.) was allowed to invade the pens to provide cover, nesting material, and shade. Mowing was done twice a year, usually in the spring and late fall.

A basic requirement of alligator farming is a reliable source of clean, fresh water. The initial water source for the pens consisted of pumping from a freshwater ditch, a distance of up to 300 feet. During drought this source was not reliable. Saltwater build up and/or intrusion was also a problem.

A 220-feet deep 8 inch water well with a 25 horsepower electric motor was installed in the fall of 1971. A system of 2 and 3 inch PVC water lines connecting the ponds and water holes was also installed. One 300' × 300' pen was completed in the spring of 1971 (Figure 1) and stocked with known age animals of both sexes. These animals were hatched at Rockefeller Refuge in September 1964 and maintained in a crowded pen until 1971.

Stocking Rates

In earlier studies conducted on Rockefeller Refuge (Joanen and McNease, 1971), stocking rates of one male and one female (wild captured) per pen were tested. The present report also documents the compatibility of domesticated alligators and the high stocking densities that can be maintained. One important aspect of this study was the determination of the maximum stocking densities of wild alligators that could be maintained in pens which provided adequate environmental requirements for each sex. Stocking rates of up to three males and six females per 0.6 acre pen were investigated during

phases of this study. However, this was much too high and the stocking densities were self regulated to the rates presented in Table 1. The majority of the females were proven nesters either captured from the wild or veterans of previous breeding studies. The bulls were captured from the wild as unproved adults or pen reared animals. Most of the pen raised males were proven breeders. Additional animals were added to the pens during the study to replace those lost through mortality or escape.

Table 1. Adult alligator stocking rates and habitat interspersion for experimental propagation pens, 1971-1975.

	Pen 1	*Pen 2*	*Pen 3*	*Pen 4*	*Pen 5*	*Pen 6*
No. Males*	1	1	1	1	1	2
No. Females*	3	2	4	2	3	5
Total Area (A.)	0.57	0.80	0.52	0.52	1.03	2.07
Water Area (A.)	0.18	0.14	0.10	0.09	0.16	0.34
Land Area (A.)	0.39	0.66	0.42	0.43	0.87	1.73

* Additional males and females were stocked at various times during the study; however, fighting with resultant deaths and escapes from the pens resulted in the relatively static rates presented above.

Feeding Methods and Rations

Feeding was accomplished as described earlier (Joanen and McNease, 1971). Several feeding sites were established in each pen. These sites were usually situated near a sunning area or a path adjacent to the water's edge used by the alligators. Trails were maintained to allow personnel free access to each feeding station. Vegetation was sprayed with a light application of bromacil week killer, a soil sterilant, as needed during the summer months to keep the paths clear. Feeding began in March of each year and terminated in late October. A feeding rate of 7 to 8 percent body weight per week was adhered to during the summer when most food was consumed.

Reproductive Biology

Adult alligators were collected during the spring, summer and fall of 1969 and examined internally to document sexual development. Anatomical and physiological assessments were correlated with field data to interpret the alligator's breeding biology.

Six more years of field observations and spot checks of internal sexual development were then conducted to augment the basic biological data collected in 1969.

Egg Incubation

The justification for artificial egg incubation is to reduce natural mortality. Early efforts at artificial incubation involved setting of eggs in tubs with natural nest materials used as the nesting medium. The clutch could then be easily transported and stored in a building where the temperature was maintained at 82 to 88° F.

As the project progressed, more innovative methods of incubation were tested. The best appeared to be setting the eggs in controlled environmental chambers at fairly constant temperature (84-85° F.) and high humidity (near 100%).

Growth Rates

Alligators were periodically captured, weighed, and measured during the course of this study. Notes on general body condition and morphology were taken. These data were then correlated with feeding rates to assess the results of the feeding program in terms of general health and reproductive productivity.

DISCUSSION OF RESULTS

Pen Size – Carrying Capacity

Twenty-six alligators were maintained in six pens on Rockefeller Refuge over a 4½ year period. Sex ratio averaged one male to 2.7 females.

One of the main objectives of this study was to evaluate pen design and spacing of available water in relation to nesting success of multiple stocked alligators of both sexes. The dimensions, pen designs, and stocking rates are presented in Table 1 and Figure 1. Pens ranged in size from .52 acre to 2.07 acres.

Female Requirements. Pens 3 and 4 were approximately the same size with equal amounts of courting and nesting areas; however, female stocking density in Pen 3 was twice that of Pen 4. During a four year period, Pen 3 produced twice as many nests as Pen 4, arguing that adequate interspersion of habitat and range was provided in Pen 3 for the four adults housed. Pen 4 was apparently stocked below its carrying capacity. Pen 1, approximately the same size as Pens 3 and 4, was stocked with three females. It produced a four year nesting effort intermediate between Pens 3 and 4.

Available water in all three pens was basically in the same proportion; one large courting area and five small ponds which served as nesting areas. The courting area in Pen 1 was slightly larger.

We determined that acceptable nesting rates could be achieved with an average of .02 acre of water interspersed in courting and nesting areas and .13 acres of land for each wild captured adult female.

Male Requirements. Multiple stocked males (more than one per pen) were used during this study to evaluate the basic requirements and pen designs which would provide two or more males the necessary life support requirements. Pens 3, 5, and 6 provided information on multiple stocked males. Pen 3 was stocked with two males at the beginning of the courtship period of 1971. This half acre pen apparently did not provide the spacing requirements needed. Fighting, and ultimately death to one male resulted shortly after the release of the two males into the pen.

Pen 5, with twice the land and water area as Pen 3, was stocked in the same pattern as Pen 3 with similar results.

Pen 6, with an area of two acres, provided interesting results. Two smaller males were stocked in the early spring of 1971 and the area was apparently sufficient in size to maintain them and normal courtship activities. Pen 6 was twice the size of Pen 5 and four times the size of Pen 3. Our observations indicate that males require seven times more area than females. Telemetric studies conducted on Rockefeller Refuge tended to verify this assumption (Joanen and McNease, 1970, 1972a).

Courtship fights usually commenced during the spring irregardless of the time of the year the animals were stocked.

Adequate space for multiple stocked males was found to be approximately one acre each. However, spacing requirements, based on one male per pen, were found to be much smaller. One-half acre pens were adequate for one adult male. Two males per pen required four times the area needed to house one adult male per pen. The multiple stocking of wild captured male animals should be discouraged due to the amount of area required for maintenance and courtship. A stocking rate of one male to three females could be maintained with reproduction in a ½ acre pen. A 50 percent reproductive rate could be expected with wild caught alligators.

A commercial alligator farm in Louisiana has enjoyed phenominal success with domesticated alligators. They were able to maintain 45 adult alligators per acre with an excellent nesting rate.

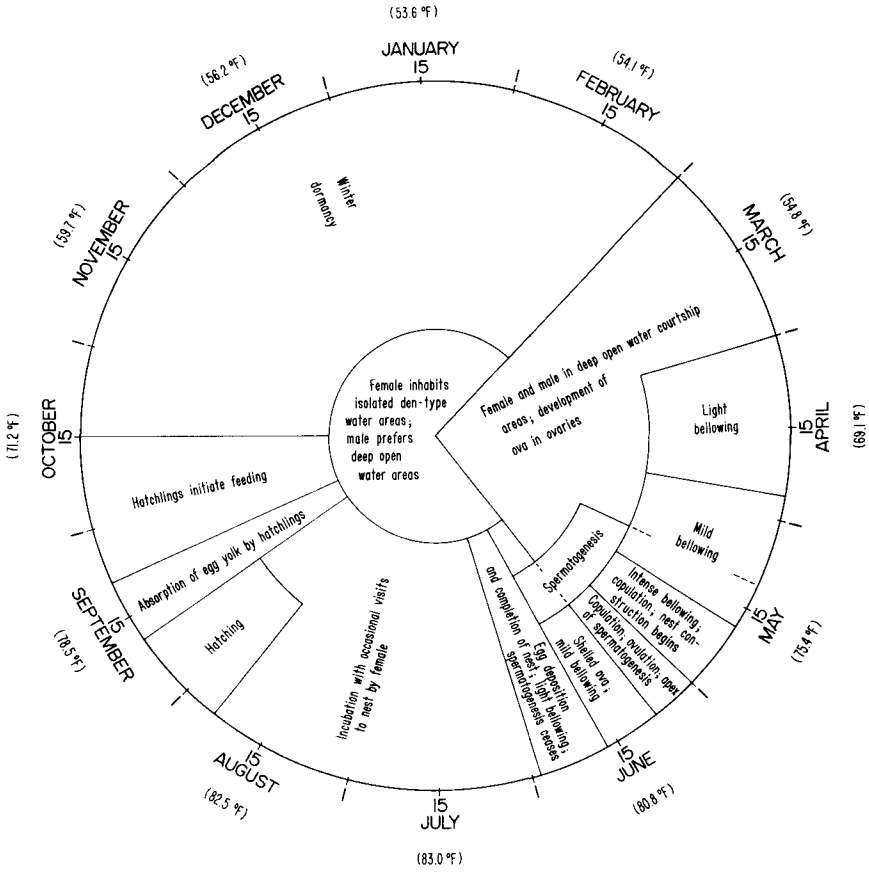
Fence Requirements. As previously determined, a 2″ × 4″ × 72″ welded wire with 24″ poultry netting installed at a 90° angle at the top proved to be the most effective fence. The life expectancy of American made welded wire fabric was approximately five years. Foreign made welded wire and poultry netting had a life expectancy of about half that. Escape was usually attempted by climbing at the corners of the fence. The alligator appeared to use the corner of each fence for support as it climbed. Elimination of acute angles in the fence is presently under investigation. A circular design may greatly reduce the escape problem.

Reproductive Biology

Figure 2 represents a generalized scheme of major events in the reproductive biology of the alligator. Data collection for this composite schematic covered 6½ years. Cut-off dates and temperatures may, of course, vary slightly from year to year. The degree of bellowing indicated in the figure was used to portray the complexity of the courtship displays.

Telemetric studies (Joanen and McNease, 1970, 1972; McNease and Joanen, 1974) have added valuable insight into sexual differences in habitat utilization. This is most important for the proper interspersion of habitat types in the original pen lay-out. Both adult males and females tended to prefer deep open water areas during the courtship period; March through the first week of June. After the courting period the females moved into isolated dens in the marsh and initiated nesting. The females normally remained in this habitat until the following spring when the cycle began again. The adult male remained in deep water areas throughout the year.

Figure 2. Chronology of reproductive oriented biology and events for a population of marsh alligators.*



* Reproductive physiology data collected in 1969, other observations cover period 1964-75.
°F — Average monthly air temperature — 1969.

Courtship activities generally began in early April with occasional light bellowing. Bellowing and courtship displays gradually built up through the first week of June.

From late May through the first week of June courtship and copulation were intense, the female ovulated, and the high point of spermatogenesis occurred. From the middle through the end of June, all reproducing females contained shelled eggs in the terminal end of the oviducts and egg deposition occurred. The time interval from ovulation to laying was 3 to 3½ weeks.

The onset of sexual maturity was about 72 inches. However, social order in males favored breeding by bulls in the 9′ and above size classes. Available data indicate that approximately 67-68 percent of the adult females reproduce in any given year (Chabreck, 1966). The average number of eggs per clutch was 39.5 (34 nests) over four successive nesting years.

All males examined in the 6′-13′ size classes were physiologically capable of reproduction. During 1969, males produced sperm from May 9 through June 20, a period of 43 days. Maximum gonadal development, hence sperm production, occurred from the last week in May through the first week in June. Dead sperm cells were first encountered during mid-June and by June 20 roughly 90 percent of

spermatogenetic activity had ceased. A significant variation was noted in sperm production between size classes. The larger males tended to produce sperm cells earlier and longer than did the smaller bulls. This, coupled with the fact that during the initial stages of spermatogenesis sperm cells in various stages of development were encountered, may help explain the reproductive superiority of the larger males.

Behavior and Courtship

Bellowing, probably the most obvious courtship activity, occurred most frequently from the first of May through the first week of June. Courtship and copulation followed much the same pattern as reported earlier (Joanen and McNease, 1971).

Fighting among males was the most serious problem encountered during this study. Interestingly, in all pens of less than two acres with two or more males, combat resulted with either death or escape of one or more of the animals. Combat between females was most frequent during the courtship period. Stocking of additional males during the summer and fall resulted in combat between the animals the following spring and usually resulted in death of the weaker animals. Females followed much the same pattern when several females were stocked into pens in which the numbers had been reduced either through escape or death. Pens stocked with one male to four females or less per ½ acre maintained these ratios throughout the study. However, pens with stocking rates higher than 1:4 resulted in combat between females ending in death or escape.

Most of the animals that died from fighting had been bitten many times at the base of the hind legs and tail and died after the open wounds became infected. In most cases the animals showed an aversion to water which accelerated the later stages of infection.

Nesting in Captivity

The egg deposition of captive animals generally was closely correlated with that of alligators inhabiting natural marsh, primarily June 12 through the first week of July, directly related to temperature (Joanen, 1969).

During the study, approximately 19 females and seven males were maintained in six breeding pens. The dominant material used in nest construction consisted of wiregrass; however, some nests were constructed of roseau cane and cattail (*Typha latifolia*). Wiregrass was the most abundant plant species in the pen, representing approximately 70 percent of the coverage.

The overall nesting success rate was 50 percent for the period 1972-1975. This is similar to the 48 percent determined in a previous study (Joanen and McNease, 1971). Two females actively defended their nests from egg deposition until the eggs were removed from the nest. One of these aggressive females had been used in earlier studies and careful records were maintained on this animal since 1964. This female tended to nest for three successive years and then skip one, skipping 1967, 1971, and 1975.

Fertility Rates

Fertility rates were determined from 11 nests produced during one nesting season. Three hundred and fifty-eight eggs were placed in incubators, 24.6 percent of which were found to be infertile. Interestingly, one male serviced four of these females, the most recorded during the study. These four females produced a total of 138 eggs, of which 15.9 percent were infertile.

Age at First Nesting

In 1964, ten alligators were hatched in incubators at the refuge headquarters and subsequently housed in a small holding pen and fed a mixture of ground fish and beef scraps. During the spring of 1971, seven of these alligators, six females and one male, were moved to a 300′ × 300′ enclosure. This pen was constructed to simulate natural conditions and was interspersed with courting and nesting areas (Joanen and McNease, 1971). As the captive male was considered small, one wild captured 88½″ male was added for breeding purposes.

Both sexes bellowed during the spring of 1971; however, no nests were built. In 1972 and 1973, bellowing was heard, although no nesting was attempted. Courtship and copulation was observed in the spring of 1974. On 8 June, 1974, a partially constructed nest was located; however, the nest was later abandoned. Two nests with eggs were later located on 29 July, 1974. One nest had 36 eggs and the other 21. One female was extremely aggressive at the nest, and the other female was never seen. The nests were smaller than wild nests. They averaged 63″ in diameter and 17″ in height. Nests in the wild were found to average 71.5 inches in diameter and 23.7 inches from the marsh floor (Joanen, 1969).

First nesting occurred at 9 years, 10 months of age. This is identical to McIlhenny's (1935) description for penned animals.

Seventeen eggs from one nest averaged 2.53 inches in length, 1.42 inches in diameter and 2.08 ounces. Fifteen eggs from the second nest averaged 2.60 inches in length and 1.47 inches in diameter with an average weight of 2.23 ounces.

The age of first nesting may vary by several years. Environmental parameters and food supplies vary considerably throughout the alligator's range and may play an important role in regulating the age of sexual maturity.

Artificial Egg Incubation

The most successful method involved incubating undamaged eggs in controlled environmental chambers. Eggs were collected in late July, allowing for three weeks of undisturbed early development, and set in wire mesh trays until hatching was complete.

Various treatments of eggs were evaluated, including washed versus unwashed, uncovered versus covered by nest (hay) material, and set over dry concrete and over water. Early results revealed no major differences in hatchability between treatments. However, refinements in techniques and new methods should improve hatching and perhaps lead to a superior method.

Hatching success averaged 75.4 percent for all nests, excluding infertile eggs. If infertile eggs are included a 50.3 percent success was achieved. This is slightly below the 58 percent reported by Joanen (1969). Artificial incubation averted the 18.6 percent nest loss associated with predation and other factors (Joanen, 1969).

Once the hatchlings began pipping we sometimes had to peel away the tough outer shell fragments. Otherwise the weaker hatchlings could not liberate themselves. This condition has not been noted in wild hatched eggs. Additional study should be directed at determining factors influencing the breakdown of the egg shell.

Water Levels in Relationship to Nesting Rates

Water levels were found to be extremely important in relation to nesting rates. Water areas, especially courting ponds, were maintained at maximum pool stage during the months of April, May, and June. Water level data collected from April, 1973 through March, 1974 indicated nesting occurred with increasing water levels (McNease and Joanen, 1974). Conversely, Cott (1961) noted that nesting activity was initiated with decreasing water levels in the Nile crocodile. Their eggs were laid during the dry season when the water level has been falling for several weeks and the incubation period coincided with the period of lowest water levels (Cott, 1961).

Aerial censuses of alligator nests conducted from 1970 to 1972 indicate that nesting rates may be correlated with the amount of surface water accumulated during the spring and very early summer of any given year. 1972 rainfall (January — June) doubled that recorded for the drought year, 1971. Nesting rates for 1972 increased 45.9 percent over the 1971 nesting effort (Joanen and McNease, 1972b), too great an increase to be accounted for by recruitment of first time breeders.

Table 2. Average growth of ten alligators hatched and reared on Rockefeller Refuge.

Date Measured	*Average Length (In.)*
9-16-64	8.50
4-6-65	10.50
8-26-65	20.30
9-15-66*	34.50
9-6-67	43.35
3-14-68**	45.29
4-7-71**	62.54
4-11-74***	69.44

*Two alligators measured.
**Seven alligators measured.
***Four alligators measured.

Growth Rates

Growth rates are presented in Table 2 for 10 domesticated alligators. These animals spent their entire life in pens and were more tranquil than wild captured alligators.

Growth rates in captivity for larger wild captured alligators were noted in an earlier study (Joanen and McNease, 1971). Additional measurements were made to augment the 1971 data. Total length and weight gain of males averaged 2.9″ and 27.4 pounds, 0.6″ and 25 pounds, and 1.0″ and 19.6 pounds per year respectively for the 8′, 9′, and 10′ size classes. One male grew 5.2″ per year from 5′ to 7′.

A comparison of female growth rates indicated an average increase per year of 2.5″ and 11.7 pounds, 0.7″ and 8.5 pounds, and 0.7″ respectively for the 6′, 7′, and 8′ size classes.

SUMMARY AND CONCLUSION

A study was conducted from 1970 through 1975 on the reproductive biology and pen propagation of alligators. Various facets of the alligator's life history were studied, along with propagation techniques such as stocking rates and pen requirements.

It was determined that alligators can be propagated under captive conditions; however, careful consideration must be given to the source of the alligators (wild or pen reared), size and shape of the pen, interspersion of habitat types, source of water supply, size and depth of ponds, and stocking rates. The majority of courtship activities occurred in May and June with high point of courtship and copulation taking place in late May and early June.

Age at first nesting for pen reared female alligators was found to be 9 years 10 months. A fertility rate of 75.5 percent was determined for 11 nests produced during 1974. Nesting rates in pens closely correlated that determined for wild alligators in previous studies.

Initial tests of artificial incubation resulted in a 75.4 percent hatching success excluding infertile eggs.

Annual growth rates under penned conditions were inversely proportional to size class, ranging from 2.5″ for the 6′ class to 0.7″ for the 8′ class in females and 5.2″ for the 6′ class to 1.0″ for the 10′ class in males.

LITERATURE CITED

Blake, D. K. 1970. Crocodile farming in Rhodesia. Department of National Parks and Wildlife Management. 44 pp. Mimeograph.

Chabreck, R. H. 1965. The movement of alligators in Louisiana. Proc. Southeastern Assoc. Game and Fish Commissioners Conf. 19:102-110.

Chabreck, R. H. 1966. Methods of determining the size and composition of alligator populations in Louisiana. Proc. Southeastern Assoc. Game and Fish Commissioners Conf. 29:105-112.

Chabreck, R. H. 1967. Alligator farming hints. La. Wildlife and Fisheries Comm. 21 pp. Mimeograph.

Cott, H. B. 1961. Scientific results of an enquiry into the ecology and economic status of the Nile crocodile (*Crocodilus niloticus*) in Uganda and Northern Rhodesia. Trans. Zoo. Soc. London 29(4):211-356.

Downes, M. C. 1973. The literature of crocodile husbandry, Proc. 2nd I.U.C.N. Survival Service Commission Meeting—Crocodile Specialist Group. (In press).

Joanen, Ted. 1969. Nesting ecology of alligators in Louisiana. Proc. Southeastern Assoc. Game and Fish Commissioners Conf. 23:141-151.

Joanen, Ted, and Larry McNease. 1970. A telemetric study of nesting female alligators on Rockefeller Refuge, Louisiana. Proc. Southeastern Assoc. Game and Fish Commissioners Conf. 24:175-193.

Joanen, Ted, and Larry McNease. 1971. Propagation of the American alligator in captivity. Proc. Southeastern Assoc. Game and Fish Commissioners Conf. 25:106-116.

Joanen, Ted, and Larry McNease. 1972a. A telemetric study of adult male alligators on Rockefeller Refuge, Louisiana. Proc. Southeastern Assoc. Game and Fish Commissioners Conf. 26:252-275.

Joanen, Ted, and Larry McNease. 1972b. 1972 coastal alligator census. La. Wildlife and Fisheries Commission. 3 pp. Typewritten report.

Joanen, Ted, and Larry McNease. 1974. Propagation of immature American alligators in controlled environmental chambers. Proc. American Assoc. of Zoological Parks and Aquariums Regional Conf. 1974:262-268.

McIlhenny, E. A. 1935. The alligator's life history. Christopher Publishing House, Boston. 117 pp.
McNease, Larry, and Ted Joanen. 1974. A telemetric study of immature alligators on Rockefeller Refuge, Louisiana. Proc. Southeastern Assoc. Game And Fish Commissioners Conf. 28: (in press).
Pooley, A. C. 1971. Crocodile rearing and restocking. I.U.C.N. Publ. (N.S.) Suppl. 32:104-130.
Pooley, A. C. 1973. Conservation and management of crocodiles in Africa. Journal South Africa Wildlife Management Association 3(2):101-103.
Yangprapakorn, U., J. A. McNeeley, and E. W. Cronin. 1971. Captive breeding of crocodiles in Thailand. I.U.C.N. Publ. (N.S.) Suppl. 32:98-101.

STATUS AND ECOLOGY OF BALD EAGLES WINTERING IN OKLAHOMA

by
JAMES W. LISH AND JAMES C. LEWIS
Oklahoma Cooperative Wildlife Research Unit
Oklahoma State University
Stillwater, Oklahoma 74074

ABSTRACT

Aerial and ground censuses of bald eagles (*Haliaeetus leucocephalus*) wintering in Oklahoma indicate a minimum population in midwinter of almost 600 eagles. The northern bald eagle (*H. l. alascanus*) is the primary subspecies found in Oklahoma. Eagles generally begin arriving in October, their populations peak in January, and most have departed by mid March. The largest concentrations of eagles are located along the Salt Fork River near Salt Plains National Wildlife Refuge (NWR), at Grand Lake, in Osage and Texas Counties, at the Wichita Mountains NWR and Sequoyah NWR, and at Keystone, Tenkiller, Eufaula, and Fort Gibson Reservoirs.

Fourteen communal roosts were found. Cottonwoods (*Populus deltoides*) are the main roost tree species. Sixty-four percent of these roosts are on private property. Fourteen percent of the roosts are threatened by human disturbance and their future is considered precarious. In the intensive study area, Canada geese (*Branta canadensis*), cottontail rabbits (*Sylvilagus floridanus; S. auduboni*), and gizzard shad (*Dorosoma cepedianum*) were the main food items. Shooting was the main mortality factor for these eagles, however, the small numbers presently known shot do not represent a threat to the stability of the entire population. A management plan is presented that recommends managing roost trees to insure tree replacement, protecting roosts from human disturbance, and an annual census.

INTRODUCTION

Studies of bald eagles have been negligible except in the subject areas of natural history, nesting activities, food habits, and effects of pesticides. Bald eagles may spend up to 8 months of the year on their wintering grounds. A review of the literature indicated that very little research had been conducted on the ecology of wintering eagles. Research needs in Oklahoma included evaluating wintering habitat, determining the location of major roosts, evaluating future land use trends at these communal roosts, censusing, determining food habits, and determining the subspecies present.

The Oklahoma Cooperative Wildlife Research Unit; The National Audubon Society; George Hulsey, President, and William Howard, Executive Secretary of the Oklahoma Wildlife Federation; The National Wildlife Federation; George M. Sutton, Professor Emeritus of the University of Oklahoma; and the Oklahoma State University Research Foundation all furnished financial assistance for this study. This report is a portion of the Master's thesis of the senior author. The junior author was major advisor for the study. The authors express their appreciation for the assistance given by graduate committee members John Barclay, Associate Professor, School of Biological Sciences; and Arthur E. Harriman, Professor, Department of Psychology. Numerous other persons provided valuable assistance, but space limitations do not permit us to acknowledge them.

STUDY AREAS

The Salt Plains National Wildlife Refuge (NWR) encompasses Salt Plains Reservoir. The refuge and an area extending 20km downstream on the Salt Fork River was the intensive study area. The Salt Fork of the Arkansas River and the Medicine Lodge River meet in northcentral Oklahoma, before flowing into Salt Plains Reservoir. Below the reservoir the river is called the Salt Fork of the Arkansas. The stream gradient is gentle and a broad flat floodplain has developed. The Salt Fork has a braided channel interspersed with numerous sand bars and flats. Field investigations also were conducted throughout the state at other areas where eagles concentrated.